REMARKS

In view of the above amendments and following remarks, reconsideration of the Office Action of July 27, 2006 and further examination of this application is respectfully requested.

By the above amendments, independent claim 24 has been amended to recite that the weight % of ytterbia is 15 weight % or more and 20 weight % or less. In addition, newly presented independent claim 43 recites that the weight % of ytterbia is 16%. Such recitation is combined with the previously recited features of the ceramics layer having cracks introduced into the ceramics layer which extend in a thickness direction of the ceramics layer in a range of ±40° relative to a normal line to a face with a ceramics layer, and not outside the range. Further, this is together with the previously recited feature of the ceramics layer having fine pores formed therein with a porosity of the pores relative to the ceramics layer being 8% or more and 15% or less.

As has been previously discussed, the object of the present invention is to enhance thermal cycle durability, i.e. to increase the resistance against peeling, of a thermal barrier coating (TBC) caused by the thermal cycle that follows starts and stops of a gas turbine, for example. By increasing the thermal durability, the TBC can withstand a greater number of thermal cycles, for example a greater number of turbine starts and stops. As has been discussed previously, in order to achieve this object, the concept of employing both the porosity as well as cracks has been adopted to mitigate the thermal stress that is the driving force of TBC peeling.

The thermal barrier coating arrangement of claims 24 and 43 includes a heat resistant alloy forming a base material and a ceramic layer formed on the base material for enhancing the heat resistance of the base material. Because the difference of the thermal expansion coefficient between a heat resistant alloy and the ceramics layer of the present invention is large, the coating of the present invention is in a situation in which peeling might occur more easily. The present inventors explored different ytterbia addition quantities, in addition to employing cracks and porosity as recited. Noting Table 1, sample 14 compares a conventional YSZ ceramics layer with embodiments according to the invention. In particular, the ytterbia addition quantity can be seen to be good in thermal cycle durability at an addition quantity of 8-27%. However, from 15-20% is clearly established as being significantly superior. Note the jump from 526 thermal cycles at an addition quantity of 10% to 3,684 thermal cycles at an addition quantity of 15%. Note the drop from 3,249

cycles to 1,245 cycles from 20-25%. Accordingly, the range of 15-20% is established by the specification as providing even further superior results.

Noting Table 2, the ytterbia addition quantity is varied with certain intervals between cracks. This table establishes that the ytterbia addition quantity of 16% is most superior, consistent with Table 1. 16 weight % of ytterbia has an extraordinarily excellent thermal cycle durability.

Turning to Table 3, while maintaining the ytterbia addition quantity at 16%, the porosity after thermal spraying was varied. This established that a thermal barrier coating had an excellent thermal cycle durability in a porosity range of 8-15%.

The Examiner now cites the combination of Rickerby with Fukudome and Nagaraj (Rickerby and Nagaraj having been previously cited).

Rickerby is directed to a metallic article having a thermal barrier coating. As stated at the beginning of the Summary of the Invention of Rickerby, the object is to provide a thermal barrier coating which has reduced thermal conductivity. As the Examiner acknowledges, Rickerby is silent with respect to both the presence of cracks and porosity. Thus, there is no goal of thermal stress mitigation by the use of cracks disclosed or suggested. In fact, it can be seen from column 8, lines 24-34, that the presence of voids is not necessarily something to be desired in Rickerby.

Rickerby provides a first metallic oxide to stabilize the zirconia, which can include ytterbia of 4-20%; the second metallic oxide, provided to reduce the thermal conductivity, is present in an amount of 5-25%, and could also be ytterbia. A third metallic oxide could be provided as well to reduce photon thermal conductivity of the TBC.

Thus, it is clear that the focus of Rickerby is reduction of thermal conductivity. There is no stated concern with the thermal life cycle. There are no cracks. There is no discussion of a desired amount of porosity, furthermore.

Further, based upon the statements of Rickerby, it appears that ytterbia could be present in an amount of 4-45 weight % as part of the first and second metallic oxides.

The Examiner acknowledges that Rickerby does not disclose cracks or the porosity percentage. Rather, the Examiner cites Fukudome as disclosing cracks formed in columnar interfaces helping to prevent peeling of the interface from the bond coat. Fukudome is also cited as disclosing a porosity of 5-30% overlapping the claimed range of 8-15%.

The Examiner initially cites that Fukudome discloses the zirconia as stabilized with 3-15% ytterbia. However, as can be seen from the cited portion of Fukudome, this refers to the mol %.

Paragraph 34 states that the mol percentage is preferably 5-12. However, 12 mol % is in fact in an area where the thermal cycle durability according to the present invention, as shown in Table 2, drops significantly. It is for example noted that the YB addition quantity of 8 mol % corresponds to 21.7 weight %. The ytterbia addition of 8 mol % is what Fukudome cites as having the highest anticorrosion ability against high temperature steam.

Accordingly, it may be seen that Fukudome differs from the present invention in both its object and in ytterbia addition quantity. While an ytterbia amount of 8 mol %, 21.7 weight %, of Fukudome establishes a thermal cycle life of about 5,000, the present invention with ytterbia at 16 weight % establishes a life cycle of 8,821.

The Examiner cites the Nagaraj reference for disclosing micro cracks to provide better erosion resistance and thus considers it obvious to provide dense micro cracks in order to further improve such erosion resistance in Rickerby and Fukudome.

Nagaraj has the inner layer without vertical cracks, and the layer is tetragonal and cubic. The second layer is completely stabilized zirconia made of fluorite and has the vertical cracks. It is generally said that a completely stabilized area arises from ytterbia in an amount of 32 weight % or more. However, in a completely stabilized area, the thermal cycle durability is remarkably reduced. In the present specification, it is mentioned at page 15, line 2 that with an addition amount of ytterbia of 25% by weight or more, a tetragonal crystal arises, the t' phase lowers, and the durability deteriorates. The t' phase contributes to the thermal cycle, and so ytterbia is preferably 25% or less. In the completely stabilized area, however, there is no t' phase.

The Examiner cites Nagaraj as teaching cracks in the TBC of Rickerby. However, Nagaraj is teaching cracks in a fully stabilized area; accepting such a teaching from Nagaraj and applying it to Rickerby would result in the weight % of ytterbia, if ytterbia were the stabilizer, falling out of the claimed range. Rickerby does not teach cracks in the partially stabilized layer. Indeed, the partially stabilized area of Nagaraj, as with Rickerby, is provided for low thermal conductivity, and there are no cracks taught by Nagaraj for such an area. Thus it would not be obvious to combine Nagaraj with Rickerby in a manner so as to arrive at claim 24 or 43. Accordingly, following the teachings of

Nagaraj teaches away from the present invention.

The Examiner cites Fukudome as rendering it obvious to provide its stabilized zirconia coatings with the invention of Rickerby "to provide improved oxidation, erosion and corrosion resistance and a relaxation of the stress due to the difference in thermal expansion between the substrate and the thermal protection layer." However, the Examiner's stated rationale fails to indicate what one of ordinary skill in the art would recognize as improvement to Rickerby from Fukudome. But if one of ordinary skill in the art follows the teachings of Fukudome, an ytterbia amount of 8 mol %, which is 21.7 weight %, would provide the highest anti-corrosion ability. However, this falls outside the claimed ranges. Accordingly, following the teaching of Fukudome teaches away from the present invention.

Rickerby teaches a broad range of 4% to 45% ytterbia. However, Applicants have claimed the superior ranges of 15-20%, and 16%, in claims 24 and 43, respectively.

Referring to MPEP §2144.05, in the case where claimed ranges overlap or lie inside ranges disclosed by the prior art, a *prima facie* case of obviousness may exist. However, the criticality of the claimed range has been established. By reference to the above discussion in the tables in the present specification, it is established that the range of 15-20% of ytterbia weight % provides a critical range. Accordingly, Applicants' specification, which itself is the subject of its accompanying Declaration, establishes the criticality of the claimed ranges, and rebuts the *prima facie* case of obviousness.

Reference is made to MPEP §2144.05(III). This section confirms the fact that Applicants may rebut a *prima facie* case of obviousness by showing the criticality of the claimed range. Such criticality is established by the specification for both the range of 15-20% and for 16%. The results that are established are the substantially and significantly increased thermal life cycles.

That section also establishes that a *prima facie* case of obviousness may be rebutted by showing that the art, in any material respect, teaches away from the claimed invention. From the Examiner's combination of references, as has been discussed above, the references go in different directions in teaching the ytterbia quantity when combined with cracks. Thus, this fact also rebuts the Examiner's position with respect to obviousness.

Accordingly, from the above it is respectfully submitted to be clear that both independent claims 24 and 43 as now presented patentably distinguish over each of Rickerby, Fukudome and Nagaraj. Indication of such is respectfully requested.

In view of the above amendments and remarks, it is submitted that the present application is now in condition for allowance, and the Examiner is requested to pass the case to issue. If the Examiner should have any comments or suggestions to help speed the prosecution of this application, the Examiner is requested to contact Applicants' undersigned representative.

Respectfully submitted,

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